REMARKS

This application has been reviewed in light of the Office action dated January 14, 2002. Claims 1-25 are pending in the application and claims 1-25 were rejected. By the present Amendment, claims 1, 14 and 23 have been amended and claims 26-31 have been added. No new matter has been added. A marked-up version illustrating the claim amendments is annexed hereto. Applicants respectfully request reconsideration of the claim rejections based on the following remarks.

Claims 1-25 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent No. 6,042,687 to Singh et al. ("Singh") in view of U.S. Patent No. 6,046,116 to DeOrnellas et al. ("DeOrnellas") and further in view of U.S. Patent No. 5,827,437 to Yang ("Yang") for the reasons set forth on pages 2-6 of the office action.

In general, claims 1, 14 and 23 are directed to methods for etching deep trenches in a substrate by, inter alia, heating a wafer to a high temperature (e.g., greater than 200 degrees Celsius), and exposing the wafer to a reactive plasma in order to etch deep trenches into the substrate of the wafer.

To establish a prima facie case of obviousness, various criteria must be met. For instance, there must be some suggestion or motivation in the references or in the knowledge generally available to one skilled in the art to combine the reference teachings. In addition, the prior art references must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination must both be found in the prior art and not based on applicant's disclosure (see, e.g., MPEP 2141, 2143, 2143.03). It is respectfully submitted that at the very minimum, for at least the reasons set forth below, the combination of Singh, DeOrnellas, and Yang is legally

deficient to establish a prima facie case of obviousness under 35 U.S.C. § 103 to support the rejection of claims 1, 14 and 23.

For example, taken as a whole, the combination of Singh, DeOrnellas and Yang does not teach or suggest forming deep trenches in a substrate by heating the wafer at high temperature during a plasma etch. Indeed, as acknowledged in the Office Action, although Singh generally discloses plasma processing, Singh does not teach a method for heating the wafer to a temperature greater than 200 degrees.

Further although DeOrnellas discloses heating a wafer, as acknowledged on page 5 of the Office Action, neither Singh nor DeOrnellas teaches a method for exposing a wafer to a reactive plasma to etch trenches in the wafer.

Moreover, although Yang arguably discloses a plasma reactor and forming trenches (Fig. 1b), Yang does not cure the deficiencies of Singh and DeOrnellas. More specifically, Yang does not teach or suggest forming deep trenches, much less forming deep trenches during plasma etching while maintaining the temperature of the wafer at a high level. In fact, Yang is concerned with a method for preventing microloading and profile microloading caused by different etch rates when trenches of different widths are formed (see, e.g., Yang Col. 2, lines 8-35). Therefore, taken as a whole, the combination of Singh, DeOrnellas and Yang does not disclose forming deep trenches in a substrate by heating a wafer and plasma etching the heated wafer, as essentially claimed in claims 1, 14 and 23.

Even assuming, arguendo, the combination of Singh, DeOrnellas and Yang discloses all the elements of claims 1, 14 and 23, it is respectfully submitted that there is no motivation or suggestion to one of ordinary skill in the art to combine Singh,

DeOrnellas and Yang as suggested in the Office Action. Indeed, the combination of the plasma etching of Singh (which does not teach heating the wafer) with the heated wafer of DeOrnellas (which does not teach plasma etching of deep trenches) with the plasma etching of Yang (which does not teach heating the wafer or forming deep trenches) is nothing more than impermissible hindsight. Indeed, Examiner has combined different elements of different references with no objective motivation for combining the teaching of the references to provide a method for forming deep trenches by heating a wafer and plasma etching the heated wafer..

The Examiner contends that it would have been obvious to modify Singh and DeOrnellas with Yang because Singh is not particular about the type of structures formed as a result of plasma etching, and the formation of any type of structures would have been anticipated in order to produce the expected result of the present invention (pg. 4 paragraph 3). It is the Applicants' position that the formation of vias, trenches, or grooves is not the same. The reason being that the formation of any of the above mentioned structures are formed within the specifications and tolerances of its intended use. The claimed inventions provide a method for constructing deep trenches during a plasma etch made possible by heating the wafer. There is a need in the industry to form deeper trenches within a substrate in order to facilitate utilizing the surface area of the substrate more efficiently without increasing the layout area. The present invention provides methods to help solve this problem, which is not disclosed, taught, or suggested in the combination of Singh, DeOrnellas and Yang.

Thus claims 1, 14 and 23 are believed to be non-obvious and patentable over the combination of Singh, DeOrnellas and Yang. Claims 2-13 depend from claim 1, claims

15-22 depend from claim 14, and claims 24 and 25 depend from claim 23. As such, these claims are believed to be non-obvious and patentable over the combination of Singh, DeOrnellas and Yang at least for the reasons given above for respective base claims 1, 14 and 23.

Claims 10, 11, 20, 21, 24, and 25 were rejected under 35 U.S.C. § 103 as being unpatentable over Singh et al. (U.S. PAT. 6,042,687). Claims 10, 11 20, 21 and 24-25 are believed to be patentable and non-obvious over Singh for at least the reasons given above for their respective base claims 1, 14 and 23. For example, Singh does not teach or suggest (as pointed to by Examiner) heating the wafer, much less plasma etching a heated wafer to form deep trenches.

Accordingly, the withdrawal of the all the rejections is respectfully requested.

Respectfully submitted,

By: Frank DeRosa
Reg. No. 43, 584
Attorney for Applicants

F. CHAU & ASSOCIATES, LLP
1900 Hempstead Turnpike, Suite 501
East Meadow, New York 11554
Telephone: (516) 357-0091
Facsimile: (516) 357-0092

MARKED-UP VERSION ILLUSTRATING CLAIM AMENDMENTS

1. (Amended) A method for etching deep trenches in a substrate, comprising the steps of:

securing a wafer to an electrode in a plasma chamber;

heating the wafer to a temperature of greater than 200 degrees Celsius; and

exposing the wafer to a reactive plasma to etch deep trenches into the substrate of the wafer.

14. (Amended) A method for etching deep trenches in a substrate, comprising the steps of:

forming a hardmask on a substrate;

patterning the hardmask;

securing a wafer to an electrode in a plasma chamber;

maintaining the electrode at a temperature of between about 200 and about 450 degrees Celsius to achieve about the same temperature in the wafer; and

exposing the wafer to a reactive plasma to etch deep trenches into the substrate of the wafer in accordance with the hardmask pattern.

23. (Amended) A method for etching deep trenches in a substrate, comprising the steps of:

clamping a wafer onto a electrode in a plasma chamber;

maintaining the electrode at an elevated temperature between of about 200 degrees and 450 degrees Celsius;

exposing the wafer to a reactive plasma including Cl_2, BCL_3, Ar, O_2, and N_2;

applying a backside pressure to the clamped wafer using He to achieve thermal contact between the wafer and the electrode such that the wafer is maintained at about the same temperature as the electrode; and

applying a bias power to the wafer electrode to accelerate ions from the plasma to achieve etching of the substrate to form deep trenches.